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A RAND NOTE

Issues in Materiel Distribution: A Background Note

I. K. Cohen, David Kassing,
John Bondanella, James Chiesa

September 1989

RAND

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This Note develops the approach for a study that would fulfill future requirements for a military supply distribution system. It is based on interviews with 45 senior Department of Defense (DOD) officials who were asked their opinions about the military distribution system. The interviews point to three primary conclusions: (1) the DOD does not have a well-integrated distribution system, (2) managers operating in today's materiel distribution system are often preoccupied with peacetime demands and are largely satisfied with their ability to meet those demands, and (3) the confederation of DOD materiel distribution systems might not perform effectively under wartime demands.

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PREFACE

On July 27, 1987, the Assistant Secretary of Defense (Production and Logistics) asked The RAND Corporation's National Defense Research Institute (NDRI) to define the research required to recommend improvements in the future DoD materiel distribution system. To help expedite this project, the DoD appointed Points of Contact (POCs) for the study at the Services, the Defense Logistics Agency, and the Joint Staff.

This Note contains information and perspectives drawn from a series of interviews with senior DoD officials, many of whom were nominated by the POCs. All interviews were completed in the fall of 1987. The authors are indebted to all those interviewed, who gave so willingly of their time, as well as to the POCs who arranged for the interviews.

The Note results from an ongoing research effort being carried out for the Assistant Secretary of Defense (Production and Logistics) by NDRI, a federally funded research and development center at RAND sponsored by the Office of the Secretary of Defense.

SUMMARY

BACKGROUND

The motivation for this effort arose when the Under Secretary of the Army, having reviewed Army mobilization and deployment capabilities, raised questions about vulnerabilities and delays in the present system and about the proper balance and capabilities of a future system. He also envisioned that substantial benefits could be derived from the simultaneous development of military combat and support equipment and distribution systems.

The Under Secretary of Defense for Acquisition responded that it would be beneficial to prepare a blueprint for a future distribution system *that would serve the entire U.S. military*. He envisioned that such a blueprint would help integrate the design of future weapon systems, the positioning of mobilization assets, and the development of requirements for future packaging, materiel handling, and transportation equipment.

In seeking to address these issues, RAND took as its long-term research objective the provision of (1) a conceptual design of a materiel distribution system appropriate for alternative scenarios; and (2) a strategic plan for implementing the preferred concept. RAND's short-term objective was to identify research topics for further study. Toward this goal, RAND secured interviews with senior DoD leadership in efforts to gather opinions about the distribution system. Some 45 DoD officials were interviewed in separate sessions in the late summer and fall of 1987. The information from those interviews, supplemented by RAND's institutional knowledge, is reported in this Note.

INTERVIEW COMMENTS

Three primary conclusions were drawn from this series of interviews. It should be noted, however, that respondents' views should not be construed as more than unevaluated hypotheses. Careful review and analysis will be needed before these views can be confirmed or refuted.

First, respondents felt that the DoD does not have a well-integrated distribution system. Instead, materiel distribution appeared to be accomplished by an amorphous "confederation" of individual activities.

Second, in the respondents' perception, managers operating in today's materiel distribution system are often preoccupied with today's peacetime demands and are largely satisfied with their ability to meet those demands.

Third, many respondents expressed a lack of confidence that the "confederation" of DoD materiel distribution systems could perform effectively under wartime demands. Interviewees called attention to severe problems in the systems' response to minor peacetime demand changes and wondered whether an uncoordinated system could meet wartime surges, when large forces must be mobilized and deployed.

More specifically, the interviewees' comments could be grouped into six broad categories:

- *Scope of distribution.* Distribution supports mobilization, deployment, sustainment, and peacetime operations. Respondents identified significant problems at each stage.
- *Future military environments.* Respondents foresaw harsher conditions on the battlefield of the future. The battlefield would be more "fluid," engagements more intense, and deployment and resupply systems more at risk of attack.
- *Civil sector developments.* Many interviewees envisioned a decline in the availability of civilian resources. Others foresaw promising civil technical and management developments.
- *Distribution planning.* Distribution is treated piecemeal throughout the DoD. Many commodities and deployment and resupply functions are managed separately. Service systems are not well integrated with joint systems.
- *Modernization.* Respondents viewed modernization efforts as uneven. Some interviewees stated that capabilities were "needlessly" duplicated. Coordination among data processing and information systems was seen as insufficient.

- *Management tools.* Respondents implied that tools to manage an integrated DoD distribution system do not exist. Visibility of materiel is lacking; backup systems are needed; and priority systems appear ill prepared to deal with wartime stresses.

KEY TOPICS FOR RESEARCH

Four key topics were identified for future research.

Topic I: The Unit-Cargo Mobilization and Development System

Significant doubt was expressed about the ability of the current distribution system to mobilize and deploy unit cargo satisfactorily. Respondents targeted the following areas for research:

- The flexibility for moving POMCUS equipment from one theater to another and POMCUS's military vulnerability;
- Mobilization response time;
- The sufficiency of air refueling assets;
- The questionable availability of sealift and mariners; and
- The compatibility and adequacy of different management systems.

Topic II: The Non-Unit-Cargo System

Non-unit-cargo distribution can be viewed from two perspectives: that of the Defense Agencies, Services, and transportation operating agencies (TOAs) and that of the Joint Staff and the supported CINCs.

The Defense Agency, Service, and TOA Perspective. If the goal is to ensure timely and efficient delivery of large amounts of non-unit cargo, system-level characteristics should be enhanced. The objective of enhancements should be to integrate distribution functions among the Defense Agencies, Services, and TOAs. Research should focus on:

- Use of objective functions, goals, and priorities common to all parts of the system;

- Rendering the cargo in the system more visible to managers and promoting more timely sharing of information among managers; and
- Devising a netted C^3 system that could assist in passing dynamic goals, information sharing, and providing special support and guidance for the several agencies.

The Perspective of the Joint Staff and the Supported CINCs. Three main issues have been identified:

- The basic disconnects between planning for non-unit-cargo C^3 at the Joint Staff level and the execution of supply, transportation, traffic management, and movement monitoring;
- The deficiencies within the Joint C^3 systems for deployment and sustainment planning and execution; and
- The many system improvements under way by the Defense Agencies, Services, and TOAs, and the compatibility of those improvements with one another and with planned enhancements to Joint C^3.

Topic III: Responsive Material Support and Its Implications for Distribution

Broad-based efforts are under way to make the logistics system more responsive. These improvements raise issues for research on the distribution system. A responsive distribution system would have to be more survivable and dependable, capable of immediate and continuous resupply, tuned to a refined priority system, and able to provide service when needed. Such responsiveness implies enhanced C^3, greater availability of transportation, and higher system integration.

Topic IV: Technology Assessment

The objectives of technology assessment should be twofold: to project trends in transportation technology and industry organization and to examine these trends for implications for the DoD distribution system. Technological developments that are likely to improve speed, enlarge throughput capacity, enhance survivability, or reduce costs should be studied.

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FIGURES

I. CHARTER AND BACKGROUND

The motivation underlying this effort can be found in correspondence exchanged in early 1987 between the Under Secretary of the Army and the Under Secretary of Defense for Acquisition. The Under Secretary of the Army had been reviewing programs aimed at modernizing Army mobilization and deployment capabilities. While doing so, he raised questions about vulnerabilities and delays in the present system and about the proper balance and capabilities of a future system. He also posited that substantial benefits could be derived from the simultaneous development of military combat and support equipment and distribution systems. After a period of review and analysis, it became obvious that problems of mobilization and deployment necessarily involve elements of the Navy and the Air Force strategic mobility forces as well as the Joint Staff. Moreover, development and acquisition issues would necessarily involve the Office of the Secretary of Defense (OSD). The Under Secretary of the Army subsequently raised these issues with the OSD.

On January 9, 1987, the Under Secretary of Defense for Acquisition responded that it might be beneficial to prepare a blueprint for a future distribution system designed to serve the entire U.S. military. He envisioned that such a blueprint would help integrate the design of future weapon systems, the positioning of mobilization assets, and the development of requirements for future packaging, materiel handling, and transport equipment.[1]

The Under Secretary of the Army endorsed the development of "a revolutionary, future physical distribution design as a baseline...for driving and evaluating the related equipment, doctrine, and facilities plans."[2] He further noted the need to provide adequate resources and to make the design a total DoD effort. The Under Secretary also suggested that the following tasks be accomplished:

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[1]Under Secretary of Defense (Acquisition), Memorandum for the Under Secretary of the Army, *Physical Distribution System Planning*, January 9, 1987.

[2]Under Secretary of the Army, Memorandum for the Under Secretary of

- Implementation of a thorough literature search;
- Establishment of a year-2020 requirements baseline, given the best assessment that could be made of global deployment, strategic and operational doctrine, and the world situation in 2020;
- Analysis of trends in commercial systems and practices; and
- Delineation of a future DoD distribution system design employing an end-to-end scope, addressing unique military needs, identifying risks and tradeoffs, considering interoperability with systems of U.S. allies, and demonstrating economy and efficiency.

On July 20, the Assistant Secretary of Defense (Production and Logistics) (ASD[P&L]) advised the Services, the Defense Logistics Agency (DLA), and the Joint Staff that the Under Secretary of Defense for Acquisition had approved a comprehensive review of the DoD's physical distribution system. The goal of that effort was to produce a conceptual design that would effectively fulfill future requirements and to create a strategic plan that would be capable of guiding the transition to the new design.[3]

To undertake the study, the ASD (P&L) turned to the National Defense Research Institute (NDRI), the OSD's federally funded research and development center at The RAND Corporation. The long-term objectives suggested by RAND were to provide a robust conceptual design of a materiel distribution system appropriate for alternative scenarios and to devise a strategic plan for concept implementation. RAND also suggested that the target year be 2010 instead of 2020.

Defense (Acquisition), *Physical Distribution System Planning*, April 1, 1987.

[3]Assistant Secretary of Defense (Production and Logistics), Memorandum for Under Secretary of the Army; Under Secretary of the Navy; Under Secretary of the Air Force; Director, Defense Logistics Agency; and Director, Joint Staff, *Future Physical Distribution Systems Development*, July 20, 1987.

Several short-term objectives were identified for the first few months of the study. Working with the assistance of the OSD, the Joint Staff, the Services, and the DLA, RAND was to secure interviews with senior leadership throughout the DoD for opinions about the need to improve the distribution system. The information gained from those interviews was to be supplemented by RAND's institutional knowledge.

This Note is a product of those short-term tasks.[4] It is concerned primarily with the development of research topics that could be undertaken in this study. It takes as its starting point the items suggested by the Under Secretary of the Army in his initial correspondence and draws heavily from the interviews conducted at the DoD.

The remainder of this paper is divided into two sections. In Sec. II, the main problems from the interviews with DoD leaders are summarized. Section III describes four key topics for research.

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[4]In addition to conducting interviews, the project staff reviewed over 135 studies, reports, and articles bearing on materiel distribution. More than 30 of these were earlier RAND studies that included logistics analysis, strategic mobility studies, reports on theater distribution systems, studies of POMCUS vulnerabilities, and papers on pertinent analytical methods. A large number of reports from other organizations--the Office of the Secretary of Defense, the Joint Staff, the Defense Logistics Agency, the four Services, the General Accounting Office, the Logistics Management Institute, the Department of Transportation, and other agencies. Examples of such earlier reports include the *Airlift Master Plan* (1983), the *Defense Intransit Item Visibility System* study (1983), the *First Report of the Commission on Merchant Marine and Defense* (1987), the *Joint Operational Planning System Description* (1975), and the *Materiel Distribution System Study* (1978). Pertinent articles from such publications as *Armed Forces Journal International*, the *Army Logistician*, *Military Logistics Forum*, *Sea Power*, and the *Air Force Journal of Logistics* were also examined.

II. SUMMARY OF INTERVIEWS

This section summarizes and interprets the results of more than 40 interviews conducted by RAND's staff on the future of the DoD materiel distribution system. The interviews served two broad purposes. First, they sought to sample the views of key personnel in the DoD regarding *problems* in the current distribution system and opportunities for improving that system in the future. Second, the interviews were intended to heighten awareness throughout the DoD that the OSD had commissioned RAND to undertake this study and that RAND welcomed participation from the members of the distribution community.[1]

Knowledgeable current and former leaders from the OSD, the Services, the Logistics Directorate (J-4) of the Joint Staff, and the DLA served as interviewees. (It was decided that interviews with the CINCs would be deferred to a later date.) The individuals were chosen for their experience in dealing with the distribution system and for their judgments on its operations. Interviewing began in July 1987 and was completed by November. Interviewees are listed in Appendix A. Since the Transportation System Center (TSC) of the Department of Transportation was a potential study participant, RAND invited TSC staff members to participate in many of the interviews. Although an interview protocol was developed and used on occasion, interviews were largely unstructured. Further, the interviews were meant to address a broad spectrum of topics but were not intended to be exhaustive in scope.

The interviews yielded a surprisingly large number of viewpoints. At the beginning, it was assumed that 10 or 15 interviews would be sufficient to gather together the main perspectives on distribution from the three Services, the DLA, the OSD, and the Joint Staff. In fact, new and important ideas and insights continued to emerge even after many more interviews.

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[1]All interviews were conducted between July and November 1987.

Each interview began with a summary of the study's background and aims. Respondents were advised that the guidance to look toward the distant future implied that suggestions should not be limited either by existing policies and organizations or by existing technology. They were asked to discuss current *problems* in system operation and to mention any ideas they might have about how to improve the system.[2] This brief introduction facilitated the discussion; some interviewees talked for an hour without pause. In some sessions, the RAND interviewers introduced potential ideas or mentioned topics that had not yet been addressed.

In addition to conducting and analyzing the interviews, RAND's study group examined a variety of documents produced over the past 10 to 15 years on the materiel distribution system. These included studies by the DoD, the General Accounting Office, the Logistics Management Institute, and the individual Services. In addition, a number of earlier RAND project reports were examined, including those on the European Distribution System for the Air Force and on methodological issues bearing on tradeoffs among airlift, sealift, and pre-positioned materiel.

The interviews produced a wealth of useful information. In this Note, we summarize the more important problems that were identified together with potential solutions posed. In keeping with the informal and qualitative nature of the interviews, we emphasize that *these points should be treated as hypotheses,* not as conclusive judgments. Following a summary of general impressions and specific points, we discuss one recent instance of failure in the distribution system that amply illustrates a number of the concerns voiced by the interviewees.

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[2]It was recognized that this emphasis diverted attention from many aspects of distribution that are thought to be well planned and managed. On balance, however, focusing on problems met the objectives of the interviews. The critiques reported obviously must be evaluated in the larger context of operating distribution systems that apparently do credible jobs in peacetime.

The points presented here were chosen according to three criteria. The first was the relationship of the interviewee's area of responsibility to the topic under discussion. When a respondent highlighted problems in his own system that he felt the project should address, we regarded that suggestion as more significant than those pertaining to other areas. The second criterion for inclusion was pertinence to the objectives of our study. The final criterion was repetition: those comments, criticisms, or suggestions that were cited repeatedly in a number of interviews, services, and agencies were viewed as more likely to represent real problems than were those that were mentioned only once or twice.

OVERALL IMPRESSIONS

Five implications were drawn from the interviews. The first is that *there is no well-established, well-understood, and widely recognized authoritative definition of the physical or materiel distribution system in the Department of Defense.* The interviews allowed us to infer *conceptual definitions* of a potential distribution system; for instance, we can report views that the system should fulfill several *functions*: mobilization, deployment (of unit-related and non-unit-related cargo), sustaining employment (through resupply to the theater and distribution within the theater), and meeting peacetime needs. Alternatively, we can define *components* of distribution:

- Materiel storage;
- Materiel handling;
- Packaging and transportability;
- Transportation;
- Materiel redistribution;
- Retrograde movement; and
- Command, control, and communications.

The DoD materiel distribution system is an amorphous concept, however, compared with the DoD system for airlift, the Navy's strategic ballistic missile submarine system, and the DoD system for recruiting military manpower. One respondent described it as a "federation of systems" composed of individual activities managed by the Services' materiel commands, their headquarters, the transportation operating agencies, and the forces. Responding to this characterization, another interviewee suggested that the weaker term "confederation" would be more applicable. None of the respondents said, "Yes, this is the DoD system, here are the organizations involved, and here is how they operate." In fact, many respondents had difficulty identifying precisely where overall responsibility for distribution lay within their Service. Perhaps as a function of that difficulty, respondents suggested that the scope of the study be broad, encompassing the wholesale and retail system, all classes of supply, CONUS operations and intratheater distribution, and all the transportation operating agencies. These comments exemplify what sometimes happens in large bureaucratic organizations when a "systems" job involves many peerlike operators. In such instances, systemwide interface responsibilities seem indeterminate, there is no apparent single leader, and the elements commonly understood to be required for good systems operations are not in evidence. Such poorly integrated systems can be expected to be costly and of questionable efficacy under high load or in instances of constrained resources.

The second general impression rests on the interviewees' belief that operations were faring reasonably well in those areas that they themselves managed. *The problems noted invariably implicated other elements of the DoD federation.* Although we did not interview anyone from the civil sector who was in a position to tell us how civil sector problems were exacerbated by the DoD's policies and practices, we did hear analogous comments from the military side: "We in Service X have organized, planned, and programmed our materiel management quite well, and it will work if the resources of the civil sector are brought to bear as they should be." There were also a number of general

characterizations such as "Well, Service X operates distribution in this fashion, and Service Y operates distribution in that fashion, and Service Z would have terrible problems in wartime." In short, each element of the DoD federation had some defenders and some critics. These comments can also be interpreted to signify a poorly integrated system: each element of the system had its own views and goals about its mission, and these were not necessarily shared by other elements of the system.

Third, *there were few suggestions for fundamental reforms to materiel distribution.* The interviews did yield a number of suggestions for minor ways in which to facilitate current system operation and a few for major changes. By and large, however, respondents did not contend that the time had come for dramatic changes in the DoD distribution system.

Fourth, *most respondents were largely concerned with peacetime activities.* Some did say, "Your study must consider the wartime situation and plan a DoD materiel distribution to support combat forces," but in general respondents were preoccupied by current concerns. Many of the proposed improvements dealt with peacetime issues such as better techniques for meeting peacetime order and ship times or improving the system so that accounting data could be made more readily available and more accurate.

The final general impression, derived by implication, is that respondents *had little confidence in the ability of the materiel distribution system to operate effectively in wartime.* This view was expressed in several ways. One set of comments suggested that if the DoD distribution system could not adequately handle relatively small incidents like Grenada, then problems would certainly arise from the massive demands of a large and long war. A second set of observations highlighted a multiplicity of uncoordinated individual systems that would not be able to bear the strain of a large wartime surge in demand and still continue to work together. Yet another expression of lack of confidence in the system lay in some individuals' expressed plans to take matters into their own hands: "I'll jump into my jeep and I'll

take charge of my own supply myself." All this suggested that many interviewees had little confidence in the system's ability to support the forces in deployment and in combat.

SPECIFIC COMMENTS

We were able to identify six perspectives or general conclusions supported by the specific comments made by our interviewees:

- The future military environment will be tougher;
- Distribution must consider basic military functions, i.e., mobilization, deployment, sustained employment, and peacetime support;
- System operations and plans are not well integrated;
- Modernization is uneven and uncoordinated;
- Civil-sector developments will affect DoD distribution; and
- Management tools are lacking.

We organize our presentation of specific comments in accordance with these perspectives, as they are more meaningful to our research design than, say, a breakdown according to respondent function (operation, supply, etc.) or Service.

The Future Military Environment

Many uncertainties surround the future battlefield environment: Where will wars be fought? How will they be fought? What do new technologies--e.g., superconductors, very high speed integrated circuits (VHSICs), and high-speed surface ships--imply about future combat? On balance, however, the future military environment is expected to be harsher than the environments of wars in the mid-twentieth century. In the views of those in the Army and the Air Force who have addressed future technologies and doctrine, the battlefield of the future will be much more fluid than even the most rapidly changing fronts of World War II. Many small units will be constantly on the move, engaging one another. Plans for frontal warfare will be replaced by concepts for

mobile warfare. The intensity of the individual engagements is expected to be much higher than that experienced in the past, whether intensity is measured by the rate of expenditure of munitions, the rate of loss of major items of equipment (tanks, trucks, armored personnel carriers, or airplanes), or the casualty rate. It is expected that in future combat, both sides will attack deep into the opponent's rear areas to disrupt the forward movement of his forces and the coordination of his command and logistic activities.

Because of the depth of attack, distribution systems will become increasingly vulnerable to enemy actions. Tactical air strikes to the rear, missile strikes, and special operations or *Spetsnaz* activities will subject the distribution systems to interruption, disruption, and loss of communication at many levels.

Several respondents called attention to political vulnerabilities that distribution activities--particularly pre-positioning--would face in future environments. Other nations may not allow materiel pre-positioned in their territory to be transferred for military operations in a different area, for example, and equipment based in a nation may not be available even for small-scale operations in other theaters without the political approval of the local leadership. Further, this may be less and less forthcoming as time goes on.

Political restrictions will also affect the ability of the United States to base materiel forward. The overseas base structure of the United States has gradually been shrinking, and many respondents expect it to continue to do so well into the future. Bases in the Philippines have been a feature of the U.S. posture in the Western Pacific since World War II. Can we be assured that they will be available in the year 2005? While base alternatives can be envisioned, the long-run trend suggests that access to overseas facilities will become a greater problem. Fallback positions will become more and more tenuous, and the costs of maintaining distribution into forward areas will rise accordingly.

Many respondents believed that future systems must be configured to support combat in what they referred to as "undeveloped" theaters as well as in developed ones. Put another way, the future distribution system must be configured to support combat in the Third World--e.g., Burma, Angola, and Chad. In such places, the infrastructure to accept deploying forces and to handle resupply simply does not exist.

In addition, special stresses and problems will become manifest at the time of transition to war. In the early stages of a war, for example, the distribution system's clients, customers, and managers will all change. In wartime, the supported commanders--the theater CINCs--become far more important in activities such as priority setting than they are in peacetime. Similarly, the location of the units being supported will change from barracks, posts, and camps to field positions, and the materiel to be shipped will change dramatically as well, both in volume and in composition. At the same time, the volume of munitions shipped will rise substantially, and the relative tonnage of spare parts and subsistence will face a concomitant decline. Analogous shifts have occurred at the start of prior wars, but future distribution activities will have less time to adapt to wartime conditions.

Many respondents anticipated that distribution systems would be saturated by large surges in demand in the early stages of a war, with some further predicting that large batches of requisitions would be placed in the system when the expectations of conflict began to rise. These requisitions would reflect the desire of field forces to prepare themselves with as much materiel as possible when conflict is impending. Logistics managers, for example, will seek to fill gaps between available stocks and their perceived requirements. Such gaps are always likely to be substantial unless the DoD obtains budgets even larger than those of the recent past--or unless planners show much greater foresight in predicting requirements and locating stocks than experience suggests is possible.

The range of uncertainties expressed by the respondents was very large. This suggests that the distribution system needs to be robust enough to cope with problems that might occur in the event that these uncertainties arise.

The problem thus becomes one of assessing the robustness of the current system. Although the system might well be able to handle some of the circumstances indicated above, new concepts may be necessary, and there are likely to be instances in which no cost-effective answer is certain to overcome all problems.

Implications for Fundamental DoD Activities

The breadth of the interview comments reflects the large domain of functions influenced by distribution, whose activities reach into all four fundamental DoD activities: mobilization, deployment, sustainment, and peacetime support. Distribution plays a unique role in each of these activities and faces a unique set of problems.

Mobilization. The mobilization system to ready the resources of the United States for war is plagued by a host of problems involving inadequate planning, failure of coordination, and inability to meet the integrated demands of a large-scale mobilization. In discussing mobilization problems, several respondents called attention to the large-scale "Nifty Nugget" exercise conducted about ten years ago, maintaining that many of the problems observed in that exercise still hold true. One observation from Nifty Nugget, for example, was that wartime priority and allocation systems were "rudimentary" and that available stocks were neither protected nor held for high-priority uses. In the interviews, respondents indicated that this situation persists. Depot managers and others familiar with depot systems said that the supply systems would operate on the rule of "first come, first served" in wartime as well as in peacetime. Nifty Nugget further pointed out that in-theater stocks were inadequate, that serious ammunition problems and shortages existed in the Services, and that the Army was short of combat service support units. Respondents indicated that these problems persist. Thus, planning, coordination, and the capacity for nationwide

mobilization remain serious issues that the DoD distribution system must be prepared to confront.

Deployment. The DoD's plans to deploy forces to the theater of conflict raise fundamental strategic issues bearing on the vulnerability of the distribution system, its adaptability to unexpected contingencies, and its ability to meet even those demands now expected. The establishment of the Joint Deployment Agency (JDA) was the main result of the Nifty Nugget exercise; the activities of the JDA have brought organization and integration to some deployment planning. Nonetheless, some respondents stated that the Joint Deployment System was neither well understood nor readily used; one respondent called it "user-hostile." As a result, the DoD was said to lack the capacity for "positive tracking" of forces during deployments. Other respondents commented on the increasing vulnerability to enemy action of materiel stored in above-ground overseas POMCUS sites as well as the political hostage effect referred to earlier.

To meet the demands of major contingencies, deployment plans require substantial support from the civil sector, but many respondents foresaw significant problems resulting from trends in supporting industries. These developments are discussed more fully below, but their essence was that the DoD would be forced to make significant investments in acquiring resources to replace eroding support from civil sector suppliers.

Respondents also cited potential difficulties in adapting airlift forces to contingencies in which tanker support, airfield use, and the like needed to be rapidly improvised. For example, the strategic bomber force is likely to be placed on a state of increased readiness at the same time that general-purpose forces are deploying. Some respondents expressed the view that the tankers would be dedicated to strategic support and would not be available to refuel other aircraft deploying overseas.

Sustainment. Interviewees frequently asserted that the ability of logistics systems to sustain forces in combat could not be assessed. One reason, of course, is the inherent uncertainty of combat situations

as demands diverge from planning factors and vary intensely from time to time. However, respondents also noted disconnects in the planning and command-and-control systems between the Services, the transportation agencies, and the CINCs. In wartime, for example, the movement of DoD materiel will be guided by Military Standard Transportation and Movement (MILSTAMP) and JDA regulations and by their supporting automated data processing (ADP) systems. Yet the ADP systems of the Services, the transportation operating agencies (TOAs), and the Defense Agencies lack compatibility with the JDA planning systems. As a result, respondents felt that the Joint Deployment System would be unable to forecast the movement of materiel to support forces in combat.

These problems were most apparent for non-unit cargo. Although requirements are identified, this is done only at a crude level--i.e., in pounds per man per day or pounds per unit per day. At this gross level, it is impossible to identify specific items, regions, destinations, or transportation modes. In short, planning for non-unit cargo is too crude to allow planning for the distribution of materiel. Consequently, the Joint Staff cannot determine whether available logistics resources can meet non-unit-cargo needs. One respondent felt that this limitation on joint planning would persist well into the 1990s.

Finally, as noted above, interviewees held that the supplying agencies would handle requisitions on a "first-come, first-served" basis. As a result, their concern was that there would be no central control of non-unit cargo. Many interviewees felt that priority setting among requisitioning activities was a critical area that needed to be addressed.

Peacetime Support. The DoD's peacetime distribution activities are large and diverse. The Air Force Logistics Command (AFLC), for example, buys, stores, issues, and distributes nearly 850,000 Air Force supply items. The total value of AFLC assets is estimated to be greater than $100 billion. In 1985, the AFLC received nearly 4.2 million requisitions, representing well over 10,000 per day. In FY 1986, the Naval Supply Systems Command managed more than 2.6 million items at its inventory control points.

Our respondents' general view was that many of the programs the DoD follows not only are unnecessarily expensive but also create systems that are unresponsive to the demands of the using units. By contrast, the managers of peacetime supply activities generally felt that their peacetime performance was good. They mentioned a variety of improvements--e.g., better visibility of materiel, bar coding, more accurate inventory records, electronic data interchange, and more efficient cargo consolidation procedures.

Lack of System Integration

It was clear from the interviews that distribution is treated piecemeal throughout the DoD. Equally evident were important distinctions between the systems that would be used to execute wartime operations and the planning systems used in peacetime to estimate support requirements for wartime. Also, the capabilities and requirements of U.S. allies were said to be given limited consideration.

Many aspects of the DoD's supply, transportation, and traffic management functions are organized separately. Each of these individual functions is concerned with its own limited responsibilities and judges itself by its own standards. The supply system satisfies its requirements when requisitions are filled and packages are delivered to loading docks. The transportation systems view their mission as receiving cargo, moving it, and delivering it to the appropriate organization, and their measure of effectiveness is generally transportation time. As one respondent put it, there are many "seams" in DoD distribution. A better perspective on DoD problems might be gained if an attempt were made to design a "seamless" distribution system.

Respondents judged distribution to be uncoordinated not only in terms of its functions but also in terms of the materiel being distributed. For example, the transportation and distribution of ammunition is generally treated separately from the distribution of repair parts, subsistence, and fuel--that is to say, each individual commodity is "stovepiped." Some saw this as a problem within the

Services, but stovepiping also had its defenders. One respondent noted that each commodity had different characteristics, thereby justifying different management systems.

It was further maintained that distribution was only partially coordinated from Service to Service. Efforts have been made to coordinate deployment planning through the Joint Deployment System, but resupply and mobilization activities are planned and conducted largely by the individual Services despite the fact that the Services will place demands on common user resources in both activities.

Planning for each potential theater of conflict is also conducted independently. If the United States is lucky, contingencies will arise independently as well, and conflicts over the allocation of common user resources will not arise. But if contingencies do occur simultaneously, problems resulting from piecemeal planning will quickly become apparent.

The formation of the USTRANSCOM represents a start at planning and managing the transportation resources of the DoD in a common wartime framework. But those three separate TOAs will retain the authority over the programming of resources, budgeting, and peacetime operations of their systems, thereby perpetuating barriers to coordination and integration. It remains to be seen how much TRANSCOM will be able to affect the planning, programming, and resourcing of transportation systems by the three service TOAs.

Unevenness of Modernization

Partly as a consequence of the piecemeal management of distribution, programs to modernize distribution have proceeded in an uneven and uncoordinated fashion. By one estimate, some $12 billion will be spent over a five-year period on the modernization of distribution systems--e.g., on the acquisition of computer hardware, the development of communications resources, the improvement of models and software, and the upgrading of warehou ing facilities. According to some respondents, this modernization effort is taking place in a context in which capabilities are needlessly duplicated; the DoD maintains complexes of warehouses whose parallel functions, in the view of respondents, could be profitably consolidated.

The information-handling capabilities and communications systems of the Services were said to lack sufficient coordination despite the many years of effort that had been committed to a joint operational planning system. In data formats, communications techniques, and the like, the Service systems appeared unable to connect either with one another or with joint systems.

Issues related to the paperwork burden imposed by distribution procedures were widely reported as well. Documentation procedures were described as excessive, cumbersome, and prone to error. Certainly, where safety and accountability considerations are prominent, control requirements result in detailed procedures. As one example, it was said that moving munitions from one supply point to another in Europe in peacetime requires 38 separate actions and the coordination of activities by seven individuals. Other respondents noted that each time a requisition is filled out or data entered there are chances for error, and that error rates throughout the distribution system impose significant problems.

Although modernization of warehousing is taking place, storage philosophies differ among the Services. Issues of where to stock the materiel, for example--near the point of supply or near the user--are resolved differently by the various Services. Warehouses are also being modernized according to different philosophies: should the materiel be brought to a man by some sort of robotic system, or should the man go to the bin and collect the item he wants? Both approaches are being pursued. While diverse approaches may be necessary in some situations, these disparities are worthy of investigation.

Some respondents further contended that while organizations such as the AFLC and the Army's Logistics Engineering Agency (LEA) maintain packaging and transportability research units, the design of materiel for packaging and transportability is being slighted.

Finally, tradeoffs between stocks for distribution and the resources of the distribution system itself were described as poorly developed. Supply and stocking decisions are made one way, and distribution resource decisions are made through a different set of

procedures. Seldom, if ever, are direct tradeoffs made between the two kinds of resources that cooperate in putting required materiel in the hands of the forces.

Effects of Civil-Sector Developments

Interviewees were further concerned that the evolution of civil transportation systems might adversely affect the availability of resources to the DoD and therefore hamper the ability of the DoD to mobilize, deploy, and resupply. For example, airlift capabilities of the sort now available in the Civil Reserve Air Fleet (CRAF) are thought to be disappearing. The hub-and-spoke routing systems now being used by commercial airlines invite the purchase of smaller, twin-engine jet aircraft that lack the range for transatlantic operations. Other respondents argued that this was a transitory phenomenon and that the future CRAF program will not suffer shortages of wide-bodied intercontinental aircraft.

Another frequent complaint, voiced not only by Navy personnel, was that sealift resources under U.S. control--even those available from major allies--are declining. In fact, in the long run, sealift useful for military purposes may essentially disappear.

Other comments concerned the ability of land transportation systems, particularly railroads, to support the DoD. Specifically, the declining services and resources of the rail industry were cited as a serious concern that was likely to impede the DoD's future ability to mobilize and deploy forces. The DoD has already invested in rail facilities--particularly roadbeds and heavy-duty flatcars--to meet unique needs. Some saw this as an indicator of times to come, when the DoD would be required to make unprecedented investments in airlift, sealift, road, and rail assets.

More generally, respondents saw potential ill effects arising from changes in the structure of the industries that supply services--particularly transportation services--to the DoD. The degree of competition among transportation modes and among the companies within a mode has an important bearing on the price that the DoD must pay to

acquire transportation, and the costs of transporting materiel are a significant element of the operating cost of distribution activities. If competition were to be reduced and those costs were to rise, the preferred distribution system for the DoD might shift.

Other negative implications of changing industry structure for the DoD derive from the possible disappearance of commercial services from some locations. Such a phenomenon is periodically observed in rail transportation, bus transportation, and even aviation as companies move in and out of some of the smaller markets. The Army, in particular, feels that the future availability of railroad services to major facilities may decline seriously. On the other hand, the DoD could benefit from the recent development of intermodal operators. These firms manage the shipment of cargo through several modes and design facilities so that cargo can be quickly transferred from airplane to truck, or from ship to truck or airplane.

Other recent developments in the civil sector could prove beneficial to DoD distribution operations. Interviewees encouraged us to look at materiel-handling systems and warehousing technologies in the civil sector to see what kinds of developments might bring about greater effectiveness and efficiency in the DoD's materiel-handling and warehousing systems. Some highlighted the concept of "just-in-time inventory" developed in the Japanese automobile industry as a potential model for DoD management of many kinds of materiel inventories, while others questioned the direct applicability of this concept to the DoD. Also stressed was the ability of bar-coding systems and "electronic data interchange" to improve visibility or to increase the speed and accuracy of distribution recordkeeping.

The slow but steady evolution of flexible manufacturing plants could also have significant implications for the DoD's future distribution system. In flexible manufacturing, plant setup costs have been dramatically reduced by computer technology and software. As a consequence, machinery can be rapidly shifted from producing one commodity or part to another at very small cost. If this technology is widely disseminated through the economy or through the DoD maintenance

community, the requirements of supply policy and warehousing could change dramatically. DoD stockpiles of finished products and parts could be reduced, for example, and flexible manufacturing could be counted on to produce what was needed when it was needed, with little lead time and little additional cost. Clearly, such a development would have an important impact on the structure of distribution systems in both peacetime and wartime.

Our respondents also suggested that we mine the lode of rapidly changing information-handling technologies and management techniques, such as artificial intelligence, expert systems, and decision aids. The software and techniques required to manage complex interactive systems in dynamic environments will certainly evolve significantly over the next 15 to 20 years. Clearly, these can affect how well the DoD is able to face the wartime demands placed upon its distribution activities.

Absence of Management Tools

Many of the respondents also implied that the tools required to manage a DoD system for distribution do not exist. One of the most frequent comments was that DoD distribution personnel need to see precisely what materiel is in the warehouses, in process, and in transportation. A number of developments are under way to provide greater visibility, but further efforts must be made.

Backup systems for logistics communications-and-control resources also merit systematic planning and coordination. Some backup systems exist today, but they are largely ad hoc and rely on the innovative thinking of present managers.

Yet another critical need of a future distribution system is a means of setting priorities for allocating scarce resources in dynamic wartime situations. Many respondents suggested that the first-come, first-served system that will apparently be used to allocate spare parts, munitions, etc., cannot reasonably be applied in wartime.

The systems for managing DoD distribution could be dramatically improved if systemwide measures of the benefits of alternatives could be assessed, allowing for tradeoffs among the major components. The

current stovepiping of individual systems leads decisionmakers to consider narrow, single-function measures of benefit. This, in turn, leads them to think of tradeoffs only within their domains. More significant tradeoffs might come to light if the system is considered in its entirety.

If an evaluation of systemwide tradeoffs is to be effective, however, some concept of organization or definition of responsibility is needed within the DoD (although this concept need not be highly centralized). Respondents from both the individual Services and the OSD indicated that it was difficult to locate the point at which the line or staff responsibilities for distribution converged at any level below the very highest. It was equally apparent that attention to distribution at the highest levels has, with some prominent exceptions, been minimal.

To provide a system for DoD distribution that would consider tradeoffs and function effectively, the DoD must have incentives, performance measures, goals, and objective functions that promote coordination among individuals in many different organizations and services. Such incentives must lead them to consider ways to make the system more effective and must also motivate them to seek suggestions or innovations that might enhance its effectiveness.

AN ILLUSTRATIVE PROBLEM: THE EUROPEAN COMMISSARY CASE

During the interview process, our attention was drawn to a recent series of events that illustrates what can actually result from some of the concerns interviewees raised.[3] Specifically, a serious bottleneck arose in the system by which merchandise is distributed to the Army's European commissaries--despite the fact that everyone had adhered to traditional performance criteria. Although this was a peacetime problem, it appeared to reflect enough of the aspects of wartime distribution to merit our attention. Further, the case is well documented, in contrast to some examples that are only anecdotal.

[3]We are indebted to Dr. Robert Keltz, Assistant Director of Transportation, Office of the Deputy Chief of Staff for Logistics, Department of the Army, for suggesting this example and providing material for this section.

What Transpired

Increase in Demand for Supplies. In early 1987, the dollar/deutsche mark exchange ratio changed drastically in a short period of time. This caused military personnel and their families in Europe to place greater demands on the military commissary system. As a result of these increased demands, many items were bought out so rapidly that the European commissary stores could not replenish them sufficiently from their normal order quantities.

Change in Priority of Demand Satisfaction. The theater command saw that the abnormal shortage of goods could adversely affect troop morale and family quality-of-life programs. Consequently, European commissary stores increased their requisitions to a level about 15 to 30 percent above that previously experienced (see Fig. 1).

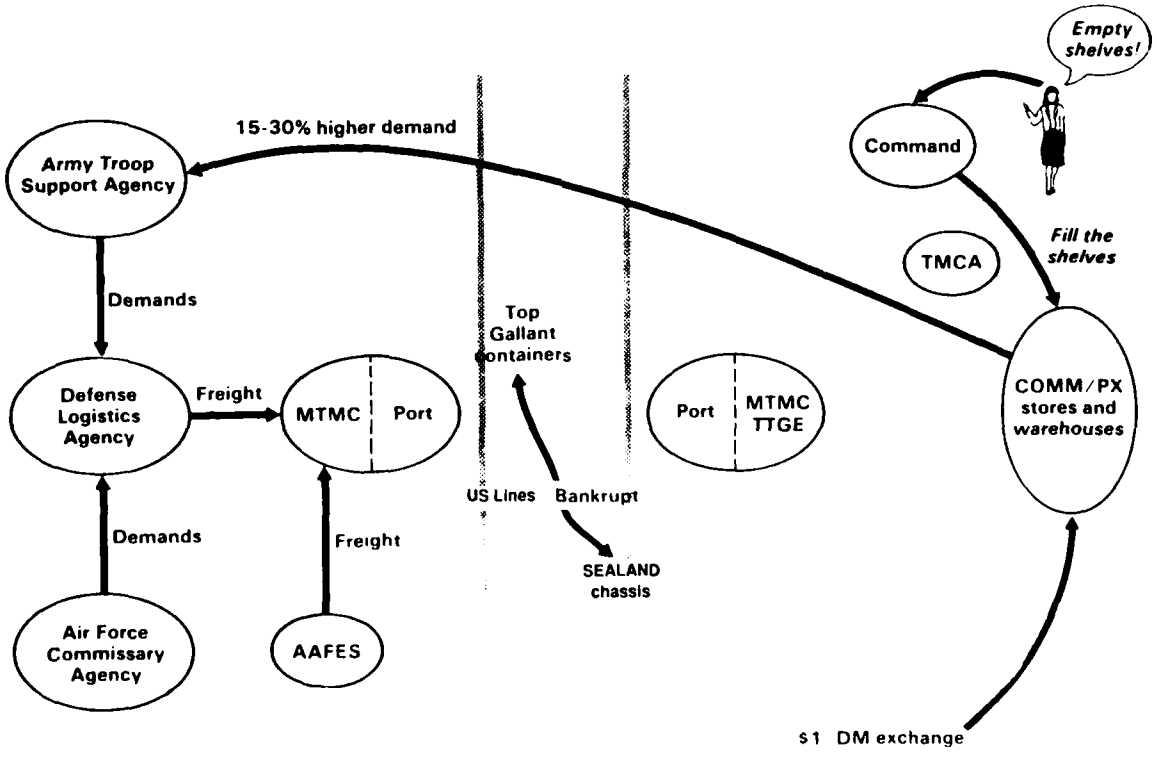

Fig. 1--The European commissary case: unexpected events

Variation in Transportation. About 5,000 containers arrive in Europe each month to meet supply requirements. These are usually shipped at fairly regular intervals, and the military strategic lift and in-theater transportation systems (some military but mostly civilian) are ordinarily able to handle the workload. The commissary situation, however, changed transportation demands as the CONUS wholesale activities tried to meet the increase in the demand for supplies.

Temporary Reduction in Availability of Transportation Assets. About the same time that the demand on the transportation system was changing, one of the primary civilian sealift companies--U.S. Lines--went bankrupt. Two other companies, SEALAND and Top Gallant, were then competing for U.S. Lines' share of the military business. Top Gallant began purchasing U.S. Lines containers and chassis; SEALAND was able to buy a large share of the needed chassis and prevent Top Gallant from purchasing enough of them to move the containers it had bought. MTMC--the Military Traffic Management Command--ultimately contracted with Top Gallant for transport services. However, Top Gallant was unable to make regular shipments. Consequently, Europe received an unexpected quantity of larger shipments on an irregular basis, with about one-quarter of the containers lacking chassis.

Inability to Handle Unexpected Supplies Efficiently Within the Theater. Containers received in Europe with chassis were shipped by means of truck transport, while those received without chassis were shipped by barge and rail to commissary stores and warehouses. However, not all warehouses could efficiently handle the irregularly arriving extra container loads with or without chassis (see Fig. 2). In-theater managers could not bring sufficient personnel and equipment to bear on the problem at appropriate times because of the variation in shipment sizes and arrival times.

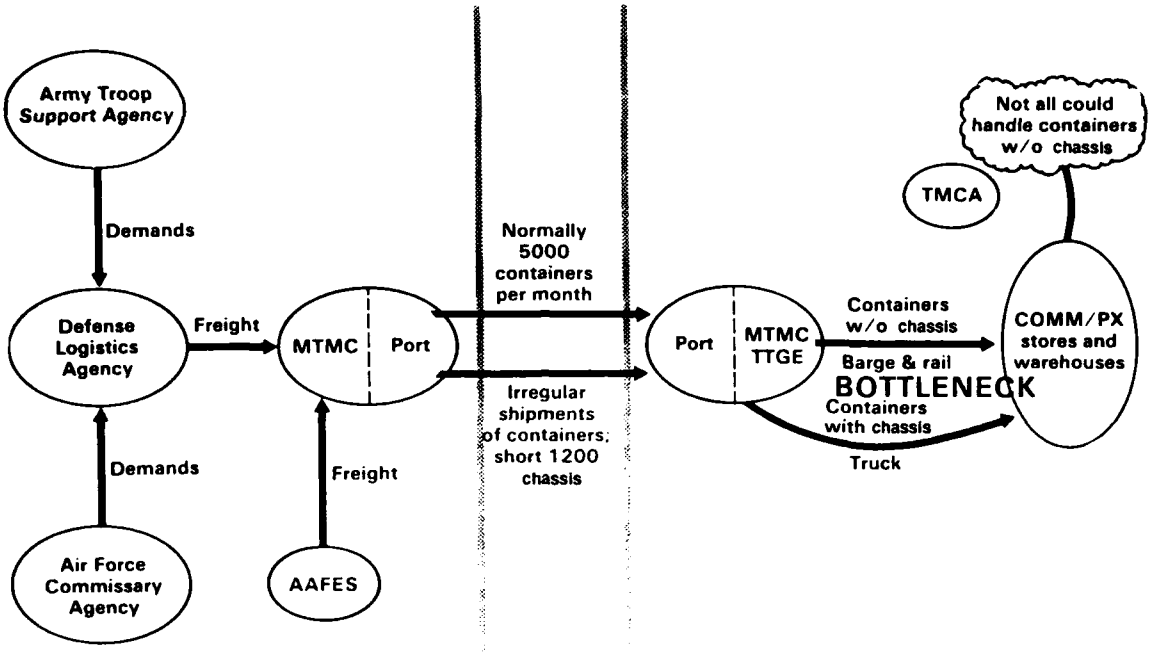

Fig. 2--The European commissary case: the result

Implications for Wartime

Examination of the commissary case allowed us to address the larger question of how uncertainty, measurement criteria, and command-and-control systems tailored to individual segments of a system may affect the performance of that system.

Uncertainties. It is evident that some "trigger event" or combination of actions can produce a substantial change in the system's environment. This event may not be recognized immediately but may qualitatively alter system operations. In the commissary case, the dollar/deutsche mark exchange ratio was just such a trigger event; in war, the amount of warning time might be a trigger event. Long warning

time might lead to an orderly transition to war, but a shorter time might disrupt plans designed for a more time-phased process.

In the commissary case, the trigger event led to a variation in demand. Variation in demand can be accommodated within certain limits; if it occurs gradually, the entire system can adapt. An almost instantaneous change in demand, however, may cause a systemwide problem. Though some specific nodes might accommodate the variance, some other nodes might not--and this could be aggravated by other unforeseen changes in the environment. Hence, a 15 to 30 percent change in commissary demand was accommodated by the wholesale system in CONUS but was not handled in theater because of the simultaneous impact of other variables. Some interviewees have suggested that there may be a 50 to 100 percent increase in demand at the start of a major conflict.

Unforeseen perturbations at selected nodes further affect total system performance. For example, the simultaneous occurrence of a common carrier's bankruptcy, the lack of sufficient chassis, and the unusual demands on the system were all unforeseen events. Even after these events occurred, their interrelationship and cumulative impact on the total system were not directly or promptly assessed. This situation could occur in war, when enemy actions could significantly affect the distribution system. The flow of supplies and the means of transport are based on certain assumptions concerning overseas stockage levels, use of air and sea lanes and ports, and ground network operations. Enemy actions may upset these plans.

Measurement Criteria. Criteria for measurement are defined for each segment of the system for both peace and war. Such criteria usually assume that optimal achievement at each particular segment will result in the most efficient performance of the overall system.

In this case, each segment tried to meet the time allotted for moving requisitions or supplies. For example, CONUS warehouses were able to meet the higher demand, and intertheater transportation did move supplies from CONUS to Europe. European ports tried to clear the containers as quickly as possible. Eventually, however, a bottleneck developed in the European commissary support system. The measurement

criterion--"keep the flow going"--resulted in problems at the retail-wholesale distribution interface, which apparently had the least flexibility in dealing with uncertainties of large magnitude. In wartime, this bottleneck might occur at the corps level.

Command-and-Control Policy and Procedures. Priorities must be established for both peace and war. These priorities could change at any time, as evidenced by the commissary example. In wartime, there are likely to be multiple overriding priorities. Although these priorities may be noted and some priority schemes changed, they could seriously impede the functioning of the distribution system. If priority changes occur too frequently, they will cause confusion in a system that operates step by step--but if they are not changed frequently enough, the system may not be perceived as responsive to the combat situation. In either case, customers whose own priorities are not being met may try to bypass the established system.

Boundary problems arise when there is limited information flow between and among the segments of the distribution system. In the commissary case, each segment was aware of some aspects of the situation, but no problems were anticipated because the information either was not passed to other segments or was not provided in sufficient time for other segments to respond appropriately. The commissary case called for the planning, forecasting, and timely assessment of significantly different transactions throughout the distribution system. Instead, the system could not even carry out simple forecasting. Planning, forecasting, and assessment of effects are likely to be even more necessary in wartime, when the distribution system must react not only to large perturbations caused by unforeseen demands but also to the effects of enemy actions.

Conclusion

There is always a potential for a bottleneck in any system as large as the DoD distribution system. The future distribution system must therefore be designed to assess situations and rapidly adapt to the environment to minimize the adverse effects of large perturbations on

forces in combat. The system should also have the ability to influence combat forces positively by providing sufficient flexibility to support alternative campaign plans in a timely manner.

III. KEY TOPICS FOR RESEARCH

We have identified four key topics for future research:

1. The unit-cargo force mobilization and deployment system;
2. The non-unit-cargo systems from the perspective of DoD agencies, the Services, and the Service TOAs as well as that of the Joint Staff and the supported CINCs;
3. Responsive materiel support and its impact on distribution; and
4. Technology assessment.

Although these inferences were drawn primarily from the interviews, not all the issues thus identified have been targeted for future research. Topics have also been drawn from the correspondence cited in Sec. I and from reviews of other research, particularly the logistics research conducted at RAND. We now elaborate on each of these topics in turn.

Information developed during the interviews was judged to be important because it came from responsible senior people. However, judgments that the current system is inadequate must, for the purposes of this study, be considered only as hypotheses subject to test through further research.

TOPIC I: THE UNIT-CARGO MOBILIZATION AND DEPLOYMENT SYSTEM

Significant doubt exists that the current distribution system can mobilize and deploy unit cargo satisfactorily. Research must therefore address the following potential problems:

- *Moving the POMCUS from one theater to another* requires concurrence from NATO and the host country. This may reduce the flexibility of the United States. Also, the vulnerability of POMCUS may be growing.

- *Air refueling assets* may be insufficient to the task of refueling cargo and combat aircraft deployed in a NATO contingency while simultaneously covering the needs of the single integrated operational plan (SIOP). This illustrates how distribution is interrelated with other important support systems.
- The *response time for mobilization* may be too long. One reason given is that it is not possible to make effective use of the railroad system. Rail heads in Army posts, for example, were said to have disappeared. Some vehicles that need to be transported by the Army cannot transit certain tunnels and bridges. This "packaging" problem apparently exists both in the CONUS and in the theater.
- Deployment would be dependent to a considerable extent on sealift. Yet it is questionable whether *enough bottoms* will be available and even more questionable whether *enough mariners* can be found to man them.
- Units are moved by *different management systems.* Movement by air employs one set of procedures, while movement by surface uses another. Differences in these procedures raise compatibility and adequacy issues.

All in all, the information acquired suggests the need for a reexamination of the current unit-cargo distribution system. If the reexamination reflects unfavorably on the current system, we will identify alternative remedies for evaluation.

One set of alternative policies that may warrant evaluation is as follows:

- Equipment could be designed to meet transportability and storage requirements.
- POMCUS materiel could be moved out of Europe to storage either at U.S. ports or aboard ships.

- "Unused" equipment at CONUS facilities could be similarly positioned.
- Ships could provide other deployment support.
- Stored equipment could be managed by contract.
- Personnel could be airlifted to marry up with their own equipment when it arrives in the theater.
- The full system could be exercised in peacetime tests.

Clearly, the interviews raised a highly significant set of issues about mobilization and deployment. Any upgrading of the present system would require the exploitation of technological opportunities both in materiel management and in air, sea, and land transportation systems. If upgrading is required, an extended period of time will be needed to effect the technological changes. To the extent that mobilization and deployment problems exist *now*, however, the DoD might want to seek short-term as well as long-term solutions.

TOPIC II: THE NON-UNIT-CARGO SYSTEM

Non-unit-cargo distribution can be viewed from two perspectives: that of the Defense Agencies, Services, and TOAs, on the one hand, and that of the Joint Staff and the supported CINCs on the other.

The Defense Agency, Service, and TOA Perspective. Many organizations are involved in handling non-unit cargo. Unfortunately, these organizations are stovepiped so that their necessary interfaces may not be as effective as they should be. (This was illustrated by the commissary case discussed in Sec. II.) A loose confederation of organizations and functions that is not integrated well enough to work under varying conditions is likely to be more costly and less effective than an integrated system. In a loose system, resources may not be properly allocated because typically the decision is made on the basis of intermediate criteria. In a well-designed system with a more meaningful effectiveness orientation, appropriate investments are more likely to be made. Thus, if the goal is to ensure timely and efficient delivery of large amounts of non-unit cargo, it is likely that system-

level characteristics will have to be enhanced. This is judged to be an important area for study.

The objective of enhancements would be to integrate the functions of the present partitions among the Defense Agencies, Services, and TOAs--i.e., to integrate them "horizontally." This integration might be provided by:

- The use of objective functions, goals, and priorities common to all the players in the system;
- Making the cargo in the system more visible to managers and sharing information among managers in time for effective decisionmaking; and
- Devising a netted C^3I system that would assist in passing dynamic goals, in sharing information, and in providing special support and guidance for operating activities.

It has been suggested that one of the reasons the distribution organizations and functions do not adequately interface with one another is that there is no explicit organization to oversee all of them. Our view for the present is that, even within a specific organization, the issue of the *means* for system integration would not go away. Integrating a system does not necessarily require reorganization. Thus, attention should be focused on the means of integration.

The Perspective of the Joint Staff and the Supported CINCs. From the viewpoint of the Joint Staff and the supported CINCs, three main issues are worthy of further investigation:

- The basic disconnects between planning for non-unit-cargo C^3 at the Joint Staff level and the real-world execution of supply provisioning, transportation planning, traffic management, and movement monitoring by the Defense Agencies, Services, and TOAs;

- The deficiencies of the Joint C^3 systems, particularly in mobilization and sustainment but also in deployment planning and execution; and
- The many system improvements under way by the Defense Agencies, Services, and TOAs, as well as the compatibility (or incompatibility) of those improvements with one another and with planned enhancements to Joint C^3.

Let us look at some of the problems in these areas more closely. Joint operations planning for the Joint Staff is done by the Joint Operational Planning System (JOPS). This system provides the CINCs with a means of developing and reviewing operational plans. Those plans include Time-Phased Force Deployment Data (TPFDD), which encompass requirements for non-unit cargo and personnel (along with force and unit deployment data). The cargo requirements are based on pounds per man per day or pounds per unit per day, which at best provide only crude estimates. Further, in contrast to the units required under the operational plan, which are specifically identified, there are no specific sources identified for the non-unit cargo required. Thus, the availability of the cargo is only grossly understood.

The consequent uncertainties may be of little significance, however, as the systems used in operational planning bear little or no relation to those used in execution. In peace and war, non-unit cargo and unit cargo are distributed in accordance with DoD policies and procedures, as reflected in the MIL-standard logistics system. There are two major exceptions: Military Airlift Command movements in wartime and Marine Corps assault follow-on via dedicated sealift.

Some significant planning occurs at the JCS level, yet significant portions of the execution occur elsewhere. This suggests a basic disconnect between the Joint C^3 systems and the Defense Agency, Service, and TOA systems. This potential problem can be termed "vertical integration."

The DoD has undertaken measures to enhance its support systems significantly. The OSD, for example, has initiated the MODELS project to replace the MIL-standard logistics systems. The formation of USTRANSCOM, too, requires the development of a comprehensive ADP systems plan, and the Joint C^3 systems are continually being upgraded. In the near term, however, neither JOPS nor the Worldwide Military Command and Control System (WWMCCS) Information System (WIS) adequately addresses the mobilization and sustainment functions. Also, it seems that there are no significant prospects for ensuring either a horizontal integration of the Defense Agency, Service, and TOA systems or a vertical integration of those systems with the Joint C^3 systems.

TOPIC III: RESPONSIVE MATERIEL SUPPORT AND ITS IMPLICATIONS FOR DISTRIBUTION

Efforts are under way across the logistics system to make such functions as procurement, manufacturing, wholesale repair, and parts repair support more responsive. Tools employed in these changes include policy, more efficient production procedures, and more advanced technology--e.g., robotics. Some of these responsiveness efforts are likely to have implications for the distribution system. For example, RAND is working on an effort to couple the CONUS depot system to the changing needs of the combat forces in the theaters. This coupling is highly dependent on a responsive distribution system.

Implications of responsive materiel support for distribution include the following:

- Increasing the burden on distribution through closer coupling of repair and manufacturing with forces, shorter resupply times, and unanticipated demands;
- Reducing warehousing needs; and
- Increasing the need for responsive distribution.

A responsive distribution system would be more survivable and dependable, would be capable of immediate and continuous resupply, would be tuned to a refined priority system, and would provide service when needed. Responsiveness suggests enhanced C^3, higher availability of transportation, and still higher levels of system integration.

For research purposes, there will be two aspects to the implications of responsive materiel support for distribution:

- Reviewing and analyzing efforts to provide responsive materiel support to assess the likelihood of success and to identify those areas that are likely to have significant distribution impacts; and
- Ensuring that the proposed distribution concept can adapt to responsive materiel support.

TOPIC IV: TECHNOLOGY ASSESSMENT

Technology assessment will be performed in the context of the other three research topics. Here it is singled out both for emphasis and to permit some matters to be discussed that are common to all topics. The objective of our technology assessments will be to project trends in transportation technology and industry organization and to examine these trends for their applicability to the DoD distribution system. Technological developments likely to improve speed, enlarge throughput capacity, or reduce costs will be identified.

Assessments will be worldwide and will cover the following:

- All modes of transportation, including air, rail, highway, marine, and pipeline--both singly and as intermodal systems;
- Logistics, including warehousing, maintenance, and order processing; and
- Relevant supporting technologies, including electronics, computation, communication, artificial intelligence, materiel, and fuels.

CONCLUSION

The selection of topics identified and discussed in this Note was heavily influenced by the interviews. The choices were also influenced by correspondence that provided the background to the study and by documentation from previous studies. Some material acquired in the interviews is not reflected in this report. However, some of the more detailed suggestions are likely to find their way into the research as it is undertaken. The contents of this document have been discussed with the sponsor, a few interviewees, some researchers at RAND, and the POCs. We think that an important set of topics--at the *system* level--has been identified. Each is worthy of study.

Appendix A

INTERVIEWEES

OSD, JOINT STAFF, and DLA

Office of the Secretary of Defense

Assistant Secretary of Defense, Production and Logistics

Dr. Robert Costello, Assistant Secretary of Defense, Production and Logistics

Mr. James Reay, Director, Supply Management Policy

Mr. Robert T. Mason, Acting Director, Maintenance Policy

Mr. Robert H. Moore, Director, Transportation Policy

Dr. John White, former Assistant Secretary of Defense, Manpower, Reserve Affairs, and Logistics

Mr. Robert Pirie, former Assistant Secretary of Defense, Manpower, Reserve Affairs, and Logistics

Program Analysis and Evaluation

Ms. Deborah Christie, Projection Forces

Office of the Joint Chiefs of Staff

Lieutenant General Edward Honor, Director J-4 (Logistics)

Mr. Bill Boone, Assistant Deputy Director for Plans, Concepts, and Analysis

Defense Logistics Agency

Major General J. E. Griffith, Director, Defense Fuel Supply Center

Mr. Laurence Kohler, Chief, Supply Management

Colonel N. R. Berkley, Director, Transportation Division

Colonel Ed Offer, Quality Assurance

Department of the Army

Mr. James Ambrose, Under Secretary of the Army

Mr. Eric A. Orsini, Deputy Assistant Secretary of the Army for Logistics

Lieutenant General Wm. Tuttle, Commanding General, Logistics Center, Fort Lee

Major General John Stanford, Commander, Military Traffic Management Command

Major General James Klugh, Assistant Deputy Chief of Staff for Logistics, Deputy Chief of Staff for Logistics

Major General C. W. Murray, Director of Supply and Maintenance, Deputy Chief of Staff for Logistics

Brigadier General Billy Stalcup, Deputy Chief of Staff, Supply, Maintenance, and Transportation, Army Materiel Command

Brigadier General Bill McGrath, Commander, Depot System Command

Mr. Barry Mc Daniel, Acting Deputy Chief of Staff, Readiness, Army Materiel Command

Dr. Robert Keltz, Assistant Director for Transportation

Mr. Charles Slyker, Deputy Director, Logistics Control Activity

Lieutanant General John Bruen, U.S. Army (Ret.)

Major General Jack Welch, U.S. Army (Ret.)

Navy Department

Navy Department: Navy

Mr. F. W. Swofford, Director, Aviation and Ordinance Programs, Assistant Secretary of the Navy, Shipbuilding & Logistics

Vice Admiral C. Smith, Deputy Chief of Naval Operations for Logistics

Vice Admiral Walter Piotti, Commander, Military Sealift Command

Rear Admiral E. Walker, Jr., Commander, Naval Supply

Rear Admiral Carl Webb, Director, Materiel Division, Deputy Chief of Naval Operations for Logistics

Captain M. D. Haskins, Assistant Director, LRP, Chief of Naval

Operations Executive Panel

Captain F. Zmorrenski, Head, Strategic Mobility, OPNAV

Captain Steve Duermeyer, Head MLSF Branch, OP-37

Captain T. Moore, Director Surface Combatant Force Requirements

Vice Admiral Thomas Hughes (Ret.), former Deputy Chief of Naval Operations for Logistics

Navy Department: Marine Corps

Brigadier General R. J. Winglass, Director, Materiel Division

Department of the Air Force

Mr. Oscar Goldfarb, Deputy for Supply and Maintenance, Deputy Assistant Secretary of the Air Force (Logistics and Communications)

Mr. Frank Coulson, Defense Transportation & Civilian Aviation Deputy Assistant Secretary of the Air Force (Logistics and Communications)

Lieutenant General C. McCausland, Vice Commander, AFLC

Major General Oberacker, Chief of Staff, Military Airlift Command

Colonel W. J. Friel, Deputy Chief of Staff, Distribution, AFLC

Brigadier General C. H. Lindsey, Jr., Director of Transportation, Hq USAF

General James Mullins, USAF (Ret.)